

Work Order ID 62003

Wednesday, September 15, 2010 9:55:21 AM

Page 1

Item ID: D3488-042

Accept

Revision ID:

Item Name: Blade Fitting Assembly, RH

Start Date: 9/14/2010 Start Qty: 10.00

Required Date: 9/21/2010 Req'd Qty: 10.00

Reference:

Approvals:

Process Plan:

Date:

Tooling:

Date:

QC:

Date:

SPC (Y/N):

Date:

Run

Start

Stop

Sequence ID/
Work Center ID

Operation
Description

Set Up/
Run Hours

Tool ID

Tool #

Plan
Code

Accept
Qty

Reject
Qty

Reject
Number

Insp.
Stamp

Draw Nbr

Revision Nbr

D3488

Rev B

100

0.00



DOOSAN LATHE

Doosan

Memo

0.00

Doosan Lathe

1-Turn as per Dwg DSK 101 & Folio FA627□2-Deburr

110

0.00



QC2- Inspect parts off machine FAI/FAIB

QC

Memo

0.00

Quality Control

120

0.00



HAAS CNC VERTICAL MACHINING #1

HAAS 1

Memo

0.00

HAAS CNC vertical machine #1

1-Machine as per Folio FA627 & Dwg D3488□2-Deburr

10.9.23

10

10.9.23

10

10/10/25

10

W/O:		WORK ORDER CHANGES					
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: D3488-042 PAR #: _____ Fault Category: machining NCR: ☒ Yes No DQA: _____ Date: 10/10/12
 Resolution: re-work Disposition: rework QA: N/C Closed: ☒ Date: 10/11/12

NCR: <u>62003</u>		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	STEP	Description of NC Section A	Corrective Action Section B			Verification Section C	Approval Chief Eng	Approval QC Inspector
			Initial Chief Eng	Action Description Chief Eng	Sign & Date			
10.9.27		Vibration occurs when machining batch # 61685. This mat'l is "grimmer" or of less hardness. This can also be seen in the surface finish of the outside Ø's.	CP 10.09.28	Open 2.150" Ø to 2.175" Re-machine soft Jaws to ensure full contact of workpiece. slow down Drill feed.	10.9.27	H.A 10/10/25	CP 10.09.28 RSI WH	10.09.28
		Vibration occurred on the inside 2.150" ± .005. R.C. PROCESS.	CP 10.09.28	slow down speed and feed of boring bar. Drill .0032 IPR > .002 IPR feed Boring Bar S400 > S320 RPM speed 1.5 IPM > 1.45 IPM feed		H.A 10/10/25	CP 10.09.28	10.09.28
			CP 10.09.28	(x2) Acceptable per attached SR		H.A 10/10/25	CP 10.09.28	10.09.28

NOTE: Date & initial all entries

Work Order ID 62003

Wednesday, September 15, 2010 9:55:21 AM

Page 2

Item ID: D3488-042

Accept

Setup Start

Revision ID:

Stop

Item Name: Blade Fitting Assembly, RH

Start Date: 9/14/2010 Start Qty: 10.00

Cust Item ID:

Required Date: 9/21/2010 Req'd Qty: 10.00

Customer:

Reference:

Approvals: Process Plan: _____ Date: _____ Tooling: _____ Date: _____

Run Start

QC: _____ Date: _____ SPC (Y/N): _____ Date: _____

Stop

Sequence ID/
Work Center IDOperation
DescriptionSet Up/
Run Hours

Tool ID

Tool #

Plan
CodeAccept
QtyReject
QtyReject
NumberInsp.
Stamp

130

QC2- Inspect parts off machine FAI/FAIB

0.00

JL 10/10/25

10



QC

Memo

0.00

Quality Control

140

QC8- Inspect parts - second check

0.00

B.A 10/10/25

10



QC

Memo

0.00

Quality Control

150

Chemical Conversion Coat per QSI005 4.1

0.00

BL 10-10-26

10



HandFinish

Memo

0.00

Hand Finishing

W/O:		WORK ORDER CHANGES					
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: _____ PAR #: _____ Fault Category: _____ NCR: Yes No DQA: _____ Date: _____

Resolution: _____ Disposition: _____ QA: N/C Closed: _____ Date: _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	STEP	Description of NC Section A	Corrective Action Section B			Verification Section C	Approval Chief Eng	Approval QC Inspector
			Initial Chief Eng	Action Description Chief Eng	Sign & Date			

NOTE: Date & initial all entries

Work Order ID 62003

Wednesday, September 15, 2010 9:55:21 AM

Page 3

Item ID: D3488-042

Accept

Revision ID:

Item Name: Blade Fitting Assembly, RH

Start Date: 9/14/2010 Start Qty: 10.00

Required Date: 9/21/2010 Req'd Qty: 10.00

Cust Item ID:

Customer:

Reference:

Approvals:

Process Plan:

Date:

Tooling:

Date:

QC:

Date:

SPC (Y/N):

Date:

Run

Start

Stop

Sequence ID/
Work Center ID

Operation
Description

Set Up/
Run Hours

Tool ID

Tool #

Plan
Code

Accept
Qty

Reject
Qty

Reject
Number

Insp.
Stamp

160

White Gloss(Ref:4.3.5.1) per QSI005 4.3-Alum

0.00



Powdercoat

Memo

0.00

Powder Coating

START TIME:

2:05

OVEN TEMPERATURE:

320°

FINISH TIME:

2:35

170

QC3- Inspect Part Finish

0.00



QC

Memo

0.00

Quality Control

180

HandFinishing

0.00



HandFinish

Memo

0.00

Hand Finishing

Install Inserts as per Dwg D3488

W/O:		WORK ORDER CHANGES					
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: _____ PAR #: _____ Fault Category: _____ NCR: Yes No DQA: _____ Date: _____

Resolution: _____ Disposition: _____ QA: N/C Closed: _____ Date: _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	STEP	Description of NC Section A	Corrective Action Section B			Verification Section C	Approval Chief Eng	Approval QC Inspector
			Initial Chief Eng	Action Description Chief Eng	Sign & Date			

NOTE: Date & initial all entries

Work Order ID 62003

Wednesday, September 15, 2010 9:55:21 AM

Page 4

Item ID: D3488-042

Accept

Setup Start

Revision ID:

Stop

Item Name: Blade Fitting Assembly, RH

Start Date: 9/14/2010 Start Qty: 10.00

Cust Item ID:

Required Date: 9/21/2010 Req'd Qty: 10.00

Customer:

Reference:

Approvals: Process Plan: _____ Date: _____ Tooling: _____ Date: _____

Run Start

QC: _____ Date: _____ SPC (Y/N): _____ Date: _____

Stop

Sequence ID/
Work Center IDOperation
DescriptionSet Up/
Run Hours

Tool ID

Tool #

Plan
CodeAccept
QtyReject
QtyReject
NumberInsp.
Stamp

190

QC5- Inspect part completeness to step on W/O

0.00



QC

Memo

0.00

Quality Control

ml 10 11 09 10

200

Identify as per dwg & Stock Location: FP-0

0.00



Packaging

Memo

0.00

Packaging

=> 10/11/09

10 9

210

QC21- Final Inspection - Work Order Release

0.00



QC

Memo

0.00

Quality Control

10/11/09
ME
10-11-10

W/O:		WORK ORDER CHANGES					
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: _____ PAR #: _____ Fault Category: _____ NCR: Yes No DQA: _____ Date: _____

Resolution: _____ Disposition: _____ QA: N/C Closed: _____ Date: _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	STEP	Description of NC Section A	Corrective Action Section B			Verification Section C	Approval Chief Eng	Approval QC Inspector
			Initial Chief Eng	Action Description Chief Eng	Sign & Date			

NOTE: Date & initial all entries

Picklist Print

Wednesday, September 15, 2010 9:55:26 AM

Page 1

Work Order ID: 62003



Parent Item: D3488-042



Parent Item Name: Blade Fitting Assembly, RH

Start Date: 9/14/2010

Required Date: 9/21/2010

Start Qty: 10.00

Required Qty: 10.00

Comments: IPP Rev:A New Issue 06-02-28 JLM
IPP Rev:B As per Rev B 06-03-30 JLM
IPP Rev:C Now On Doosan Lathe JLM Verified BY:DD

Component Item ID/ Item Name	Replacement Item ID	Mfg/ Purch	Bin Item	Primary Location	Last Location	Route Seq ID	Unit of Measure	Qty on Hand	Qty per Kit	Total Qty	Qty Issued	Date Issued	Status
---------------------------------	------------------------	---------------	-------------	---------------------	------------------	-----------------	--------------------	----------------	-------------	--------------	---------------	----------------	--------

ALS7-1032-225 Purchased No Each 747.0000 4 40



INSERT

Location

Loc Qty

Loc Code

ST282

747

100896

100

102018

47

111529

300

111581

300

1110768

x40

10-9-19
10/11/09

D6103-003

Manufactured No

Each

19.0000

1

10



Round Billet, Aluminum

Location

Loc Qty

Loc Code

MAT43

19

42281

1

55430

18

6685

(x9) (x1)

10-9-19

W/O:		WORK ORDER CHANGES					
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: _____ PAR #: _____ Fault Category: _____ NCR: Yes No DQA: _____ Date: _____

Resolution: _____ Disposition: _____ QA: N/C Closed: _____ Date: _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	STEP	Description of NC Section A	Corrective Action Section B			Verification Section C	Approval Chief Eng	Approval QC Inspector
			Initial Chief Eng	Action Description Chief Eng	Sign & Date			

NOTE: Date & initial all entries

DART AEROSPACE LTD		Work Order:	42003
Description: Blade Fitting, RH / Turning Detail for D3488-1/-2		Part Number:	D3488-2
Inspection Dwg: D3488 / DSK101 Rev: B / D		Page 1 of 2	

FIRST ARTICLE INSPECTION CHECKLIST

☒ First Article ☐ Prototype

Drawing Dimension	Tolerance	Actual Dimension	Accept	Reject	Method of Inspection	Comments
Lathe Section						
Ø2.150	+/-0.005	2.150	/		Vernier all. except where otherwise specified.	
Ø2.780	+/-0.005	2.779	/			
Ø3.125	+/-0.010	3.124	/			
Ø3.346	+/-0.010	3.345	/			
0.125 x 45°	+/-0.010 x +/-0.1°	.125	/			
8.000	+0.030/-0.000	8.015	/			
9.250	+/-0.010	9.250	/			
0.188	+/-0.010	.188	/			
R0.032	+/-0.010	R.032	/		Rad gauge	
R0.062	+/-0.010	R.062	/		Rad gauge	
Ø0.297	+0.005/-0.001	.300	/			
Ø0.430	+/-0.010	.430	/			
0.100	+/-0.010	.102	/			
0.125	+/-0.010	.125	/			
2.620	+/-0.010	2.620	/			
3.500	+/-0.010	3.500	/			
1.005	+/-0.010	1.005	/			
Ø0.484	+0.005/-0.001	.485	/			
1.180	+/-0.010	1.180	/			
3.150	+/-0.010	3.150	/			
3.070	+/-0.010	3.070	/			
R0.063	+/-0.010	R.063	/		Rad gauge	

W/O:		WORK ORDER CHANGES					
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: _____ PAR #: _____ Fault Category: _____ NCR: Yes No DQA: _____ Date: _____

Resolution: _____ Disposition: _____ QA: N/C Closed: _____ Date: _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	STEP	Description of NC Section A	Corrective Action Section B			Verification Section C	Approval Chief Eng	Approval QC Inspector
			Initial Chief Eng	Action Description Chief Eng	Sign & Date			

NOTE: Date & initial all entries

DART AEROSPACE LTD		Work Order:	62003
Description: Blade Fitting, RH / Turning Detail for D3488-1/-2		Part Number:	D3488-2
Inspection Dwg: D3488 / DSK101 Rev: B / D		Page 2 of 2	

Drawing Dimension	Tolerance	Actual Dimension	Accept	Reject	Method of Inspection	Comments
Milling Section						
Ø0.508	+0.006/-0.001	-508	✓		vern JL-3	
0.750	+/-0.010	.748	✓		HG	
1.500	+/-0.010	1.500	✓		vern JL-3	
11.18	+/-0.030	11.182	✓		HG	
R0.062	+/-0.010	-0.062	✓		R-G	
0.125	+/-0.010	.127	✓		vern JL-3	
0.590	+/-0.010	.589	✓		HG	
0.793	+/-0.010	.795	✓			
1.351	+/-0.010	1.349	✓			
1.317	+/-0.010	1.317	✓		vern JL-3	
1.802	+/-0.010	1.806	✓		HG	

Measured by: AD/SL	Audited by: H.A	Prototype Approval:	N/A
Date: 10-9-25/10/10/25	Date: 10/10/25	Date:	N/A

Rev	Date	Change	Revised by	Approved
A	06.03.31	New Issue	KJ/JLM	
B	08.09.19	Reformat P/O D3488-042	KJ/JLM	
C	08.12.02	Dimension 8.000 removed	KJ/JLM	

W/O:		WORK ORDER CHANGES					
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: _____ PAR #: _____ Fault Category: _____ NCR: Yes No DQA: _____ Date: _____

Resolution: _____ Disposition: _____ QA: N/C Closed: _____ Date: _____

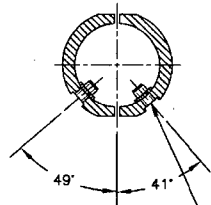
NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	STEP	Description of NC Section A	Corrective Action Section B			Verification Section C	Approval Chief Eng	Approval QC Inspector
			Initial Chief Eng	Action Description Chief Eng	Sign & Date			

NOTE: Date & initial all entries

SHOP COPY

DELIVER TO

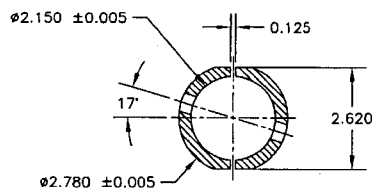
ENGINEERING
UNCONTROLLED COPY
SUBJECT TO AMENDMENT
WITHOUT NOTICE
WORK ORDER
NO. 42002
BLD-915



SECTION B-B

Ø0.297
C'BORE Ø0.430 x 0.100
INSTALL ALS4-1032-225 (OR AKS4-1032-225
OR ALS7-1032-225 OR AKS7-1032-225)
INSERTS AFTER FINISH
(4 PLACES)

4



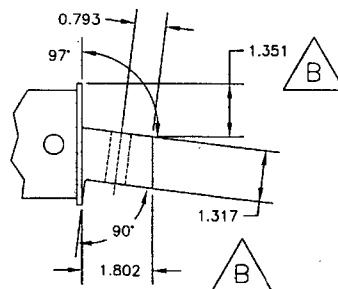
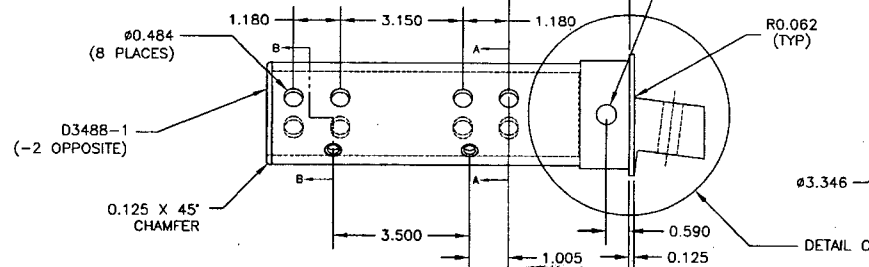
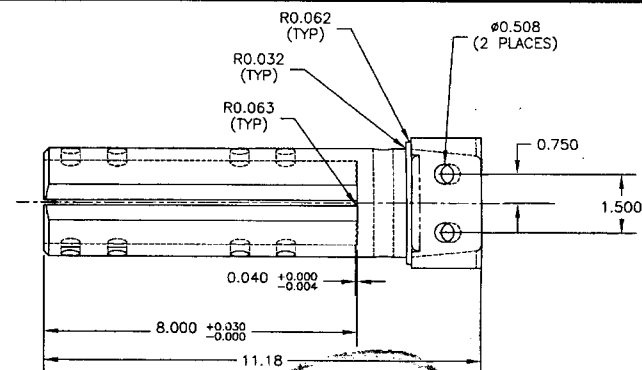
SECTION A-A

D3488-041/-042 BLADE FITTING ASSEMBLY PARTS LIST

QTY -041	QTY -042	PART NUMBER	DESCRIPTION
X		D3488-041	BLADE FITTING ASSEMBLY (LH)
	X	D3488-042	BLADE FITTING ASSEMBLY (RH)
1		D3488-1	BLADE FITTING (LH)
	1	D3488-2	BLADE FITTING (RH)
4	4	ALS4-1032-225 or AKS4-1032-225 or ALS7-1032-225 or AKS7-1032-225	INSERT

D3488-041/-042 BLADE FITTING

- MATERIAL: MAKE D3488-1/-2 FROM ALUMINUM 7075-T7351 ROUND BAR
PER QQ-A-225/9
(REF. DART MATERIAL SPEC M7075T73R)
- FINISH: ACID ETCH, ALODINE PER DART QSI 005 4.1
POWDER COAT WHITE (REF 4.3.5.1) PER DART QSI 005 4.3
- BREAK UNMARKED SHARP EDGES 0.010 TO 0.020
- INSTALL INSERTS AFTER POWDER COAT
- ALL DIMENSIONS ARE IN INCHES
- TOLERANCES ARE PER DART QSI 018 UNLESS OTHERWISE NOTED



DETAIL C

D3488-041 SHOWN (D3488-042 OPPOSITE)

RELEASED
04-05-09 PH
PER DS
ECN #739

B	06.03.15	CHANGE THICKNESS
A	05.12.20	NEW ISSUE
DESIGN	PH	DRAWN BY PH
CHECKED	#	APPROVED #
DATE	06.03.15	TITLE
		BLADE FITTING
		SCALE 1:3

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DART AEROSPACE USA, INC.

DART DART AEROSPACE USA, INC.
PORT HADLOCK, WA

DRAWING NO. D3488
REV. B
SHEET 1 OF 1

W/O:		WORK ORDER CHANGES					
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: _____ PAR #: _____ Fault Category: _____ NCR: Yes No DQA: _____ Date: _____

Resolution: _____ Disposition: _____ QA: N/C Closed: _____ Date: _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	STEP	Description of NC Section A	Corrective Action Section B			Verification Section C	Approval Chief Eng	Approval QC Inspector
			Initial Chief Eng	Action Description Chief Eng	Sign & Date			

NOTE: Date & initial all entries

5.4 Blade Comparison

The AS 350/355 skid tubes have a blade installed at the aft end of the skid tube to improve the transfer of load into the skid tube during landing, as is shown in Figure 5 of Reference 1. This blade is made of steel with the properties determined by the test documented in Reference 3 Page 3. Load is transferred to the AS skid tube using a machined fitting that is essentially tubular with provisions to bolt on the steel blade. This tube fitting is 9" long and slides into the aft end of the AS 350/355 skid tube. The blade is fastened to the tubular fitting using two 12 mm screws.

Drawing D2741 specifies the blade to be used in the Dart 350 skid tube design. This blade has identical overall dimensions as the AS part and is manufactured from 4130 steel with the same mechanical properties as the AS part. In the Dart system, fitting D2742 will be used to transfer load from the blade into the web of the skid tube assembly. On the outside of the skid tube, D2742 is dimensionally identical to the AS blade fitting. On the inside of the skid tube, D2742 has been designed to withstand higher bending moments than the AS fitting. Blade D2741 is fastened to D2742 using two 1/2" screws, which will be capable of transferring larger tensile loads than the 12 mm screws used in the AS 350 design.

The following table summarizes the analysis above and shows that the Dart system will be as good as or better than the AS system at transferring the tail down landing loads into the landing gear.

<u>Component</u>	<u>AS 350 Skid tubes</u>	<u>Dart 350 Skid tubes</u>
Blade Ft _u	151.9 ksi (from test)	152 ksi (D2741 dwg)
Blade Ft _y	140.3 ksi (from test)	141 ksi (D2741 dwg)
Blade bolts	2 x 12 mm (0.47") dia.	2 x 0.50" dia.
Fitting Ft _u	66.5 ksi (from test)	81 ksi (D2742 dwg)
Fitting Ft _y	61.3 ksi (from test)	71 ksi (D2742 dwg)
Fitting bolt	1 x 12 mm (0.47") dia.	1 x 0.50" dia.

The following calculations compare the bending moment transfer capabilities of the AS blade fitting vs. the Dart blade fitting at section A-A of Figure 5 in Reference 1.

Tensile Yield Allowables

$$M_{2y} := \frac{F_{ty4} \cdot I_{f2}}{c_{f02}} \quad M_{2y} = 55518.8 \cdot \text{lbs} \cdot \text{in} \quad \text{Max yield bending moment (Dart)}$$

$$M_{1y} := \frac{F_{ty3} \cdot I_{f1}}{c_{f01}} \quad M_{1y} = 45432.5 \cdot \text{lbs} \cdot \text{in} \quad \text{Max yield bending moment (AS)}$$

$$MS7 := \frac{M_{2y}}{M_{1y}} - 1 \quad MS7 = 0.22$$

$$M_{2y} = \frac{57,000 \cdot (2.778^4 - 2.175^4) \frac{\pi}{64}}{1.389} = 74890 \text{ lbs} \cdot \text{in}$$

STRONGER THAN ORIGINAL DESIGN
S. OK *AP 10.05.28*

Tensile Ultimate Allowables

$$M_{2y} := \frac{F_{tu4} \cdot I_{f2}}{c_{fo2}} \quad M_{2y} = 63338.35 \cdot \text{lbs} \cdot \text{in} \quad \text{Max ultimate bending moment (Dart)}$$

$$M_{1y} := \frac{F_{tu3} \cdot I_{f1}}{c_{fo1}} \quad M_{1y} = 49286.48 \cdot \text{lbs} \cdot \text{in} \quad \text{Max ultimate bending moment (AS)}$$

$$MS8 := \frac{M_{2y}}{M_{1y}} - 1 \quad MS8 = 0.29$$

$$M_{2y} = \frac{68,000 \times (2.778^4 - 2.175^4) \pi}{1.389 \cdot 64} = 89,342 \text{ lbs} \cdot \text{in}$$

5.5 Fatigue and Stress Corrosion Cracking

STRONGER & ACCEPTABLE $\phi_{10,09,28}$

Stress corrosion cracking is the result of the combined effects of a corrosive environment and a static tensile stress. Stress corrosion cracking can result from the weight of the aircraft creating a static stress in the skidtube while the aircraft is sitting on the ground in a corrosive environment. The Dart Round-I-Beam skidtube design eliminates the problems of stress corrosion cracking longitudinally along the skidtubes because localized loading is transferred into the vertical member of the skidtube assembly. In the conventional round tube design, localized loads deflect the tube into an obround shape causing large stress regions both on top and bottom as well as longitudinally along the sides of the skidtube. Section 5.2 of this report demonstrates that the Dart configuration can take much larger localized loading than the AS configuration. Therefore, for a constant load, the Dart design has alleviated the problem by placing the primary load carrying member (the web of the I-beam) within the sealed environment of the skidtube.

Dart skidtubes are manufactured from 6061-T6 aluminum which is much better than 2024 in terms of fatigue life and resistance to corrosion and stress corrosion cracking. The data supporting the improved fatigue resistance is provided in Reference 2 on Pages 4 and 5. A table taken from the ASM Metals Handbook Desk Edition is included in Reference 2 on Page 6. This table documents the significantly improved resistance to corrosion and stress corrosion cracking for 6061-T6 as compared to 2024.

To summarize: fatigue and stress corrosion cracking resistance has been improved by designing a skidtube with lower stress levels, both static and fatigue, by selecting materials which are more resistant to fatigue and stress corrosion cracking, and by placing the primary load carrying member in a sealed environment, shielded from corrosive materials

5.6 Load Transfer into Crosstubes

On the AS 350/355 series of aircraft, the saddles are an integral part of the cross tubes. Dart will not be changing these saddles or the fasteners used to attach the skidtube to the crosstubes. Therefore, the moments transmitted into the crosstubes will be exactly the same.